THE DENTAL PRACTITIONER

AND DENTAL RECORD

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Vol. VIII, No. 5 January, 1958

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. VIII, *No.* 5 — January, 1958

CONTENTS

PAGE

EDITORIAL: PROSPECTS FOR 1958 - - - - - - - - 129

THE POST-RETAINED CROWN - *E. L. Hampson, M.D.S. (L'pool), H.D.D. (Edin.), F.D.S. (Eng.), and J. Clarke, L.D.S. (Sheff.)* 130

THE VALUE OF ULTRA-VIOLET LIGHT IN MACROSCOPIC EXAMINATION OF TEETH *K. P. Durkacz, M.D., L.D.S., and S. F. Mglej, Vet. Sc. D., Vet. Med. D.* 136

A STUDY OF THE GROWTH IN HEIGHT OF THE ALVEOLAR PROCESS: O'MEYER'S SIGN *R. X. O'Meyer* 140

CURRENT TRENDS IN PERIODONTAL RESEARCH *James A. English, U.S.N., Ph.D., D.D.S.* 151

BOOK REVIEWS - - - - - - - - - - 158

NEW MATERIALS AND APPLIANCES - - - - - - - 159

LETTERS TO THE EDITOR - - - - - - - - 160

ABSTRACTS FROM OTHER JOURNALS - - - - - 135, 139, 150, 160

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. VIII, No. 5 January, 1958

EDITORIAL

PROSPECTS FOR 1958

THE new year always brings a crop of New Year Resolutions, most of them just wishful thinking, but some are acted upon and even kept. Our thought processes at this time tend to review the past year and look to the coming year for improvement. Reviewing the past year and looking to the future of dentistry it becomes apparent that 1958 will be a critical year for the profession. Unless some positive step is taken and a definite policy decided in 1958, there is a danger that the present position of dental treatment in this country will degenerate into a condition of national urgency. Over the years successive Government reports have all told the same story. There is all the proof in the world to show that not only is there a shortage of dentists but that there will be an even greater shortage after the predicted retirements of 1958, ten years after the institution of the National Health Act. It is already 1958. After a country-wide campaign for more dental students we are now in the absurd position of universities having to refuse acceptance to more than half of them as there are no places in the restricted facilities of our dental schools. The cart was never put before the horse in a more effective way. There is a possibility that there may be a restriction in the number of medical places in the universities, and presumably it will be suggested that would-be students should take up the study of dentistry. But where? It may also be presumed that those members of the profession who wish to retire in 1958 will be asked to stay on a little longer. This is obviously no solution, and in fact only aggravates the conditions under which the dental profession has had to carry a heavy burden with little or no thanks for the past ten years.

It must be realized that until the dental schools are enlarged or rebuilt in accordance with the ideas and ideals expressed by so many authoritative people, then the future of the profession is in jeopardy. Despite the present trend of cuts in public expenditure, we have reached a point where any sort of economy in university education is undoubtedly false economy and ultimately the persons who pay dearly for it are the patients who require urgent treatment.

This is not a question of politics or a demand for more than our fair share. It is a simple plea for action about which everyone is united. It is a simple plea, not for to-day but for to-morrow, and for the thousands of young children who will be denied treatment if this year of 1958 fails to improve the known difficulties of educating future members of the dental profession.

THE POST-RETAINED CROWN

By E. L. HAMPSON, M.D.S. (L'pool), H.D.D. (Edin.), F.D.S. (Eng.),
and J. CLARKE, L.D.S. (Sheff.)

WHEN the crown of a tooth is so damaged that it cannot be restored with an inlay, a plastic filling, or a jacket crown, it can be restored with a post-retained crown if the supporting tissues of the tooth are healthy and if there is enough of these tissues to withstand the forces of mastication. The post-retained crown is usually employed to restore anterior teeth, although it can be used to build up posterior teeth. The Richmond crown, which has a cap and collar encircling the periphery of the root face, undoubtedly has greater retention, but it is condemned by modern operators because it irritates the gingival tissues. Since porcelain dowel crowns have become scarce and are no longer manufactured in Britain, the acrylic resin post crown (*Fig.* 1, A) has been widely used. It has been found that a crown of this type is often unsatisfactory for reasons which were discussed by Lawton and Myers (1951) and also because of a difference in coefficients of thermal expansion of acrylic resin and stainless steel (81×10^{-6} and 11×10^{-6} respectively). When the crown has been processed and is cooling, the acrylic resin and the metal will have to shrink together because of the retaining action of the serrations on the metal post. Because their coefficients of expansion differ the acrylic resin should shrink seven times as much as the stainless steel or six times as much as gold. Wesley Johnson and Matthews (1948) point out that this will produce internal strains, particularly at the junction of the metal and acrylic resin where the restrictive action is greatest.

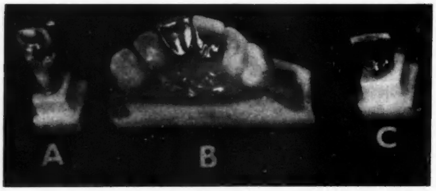
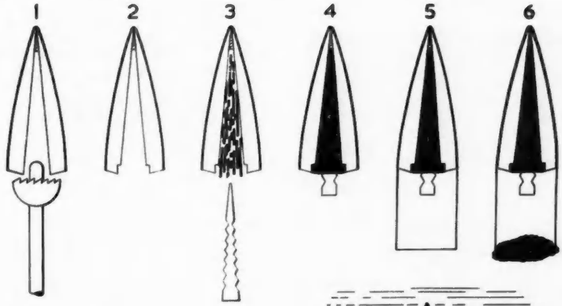


Fig. 1.—Post-retained crowns made in clear acrylic resin to show the method of construction and with gold backings faced with acrylic resin.

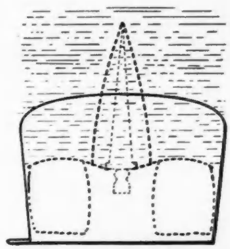
The crowns which are now to be described do not have the disadvantages of the all-acrylic resin post crown and are made so that they can be easily repaired if fracture of the crown or deterioration of the acrylic resin occurs; and the repair can be carried out without the need to remove the post, a process which is often difficult and hazardous.

The root face is prepared by the standard methods or by the one described by Lawton and Myers (1951). The bulk of the coronal tooth structure is removed with a wheel stone about $\frac{5}{8}$ in. in diameter and $\frac{1}{16}$ in. thick. The root face is cut with a labiolingual convexity which more or less follows the curvature of the gum tissues so that two planes are established, one towards the labial aspect and the other towards the lingual. On the lingual side the margin of the preparation is level with the crest of the gum, but for æsthetic reasons the labial plane must be dropped just below this level. This, however, is only advisable where there is a definite cervical crevice. Stones are not used for this part of the preparation because damage to the gingival tissues might result. To avoid such damage a root facer is employed (*Fig.* 2, 1). This instrument has a centring pin which can be placed in the root canal (*Fig.* 2, 1) so that its cutting edge can be tilted towards either the labial or lingual part of the root face and can cut that surface without damage to the gingival tissues. Any dentine or enamel lying beyond the circumference of the root facer can be removed with a chisel or enamel cleaver. The root canal is then countersunk with a No. 10 rosehead bur and from it a V-shaped extension is cut to prevent the crown rotating. When the root face has been prepared impressions and a bite must be taken. The impression of the root canal (*Fig.* 2, 2) is obtained by using a piece of 1-mm. German silver wire which has to pass to the end of the prepared root canal and

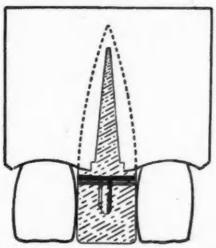
project about 4 mm. above the root face. The wire is tapered so that it will pass as near to the end of the root canal as possible and serrated (*Fig.* 2, 3). The part which projects above the iron, and copper-formed to produce a die similar to the one shown in *Fig.* 3, 3. A comprehensive impression of the root face and of one or two adjacent teeth (*Fig.* 2, 7) is taken



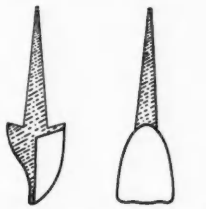
1. Showing position of root facer while tooth is being prepared.
2. Root face prepared showing countersinking.
3. Root canal filled with pieces of composition.
4. Root canal with serrated hot wire inserted into composition.
5. As for 4, but with copper ring in position.
6. As for 5, but with composition in copper ring.



7. Plaster impression of serrated wire and inlay wax in root canal.



8. Model with casting of metal post and Steele's type of backing.



9. Finished crown showing metal backing and post.

Fig. 2.—Stages in taking the impressions of the root canal, root face, and adjacent teeth.

root face is bent in a loop so that the impression compound or wax will stick to it. After the root canal has been lubricated with a fine oil or Teepol it is filled with small pieces of compound. The wire, which is held by sniped-nose pliers, is warmed and plunged into the canal. When the composition has hardened a copper ring impression is taken of the root face with the wire still in place (*Fig.* 2, 5). After the impression has been removed it is treated with colloidal graphite and reduced in plaster-of-Paris at the same time as the impression of the root face and root canal. To make it easy to place the die correctly into this impression another piece of wire is fitted to the root canal, which is again lubricated and filled with pieces of composition. The plaster impression is taken over this wire so that the wire and its impression of the root canal are withdrawn with the plaster (*Fig.* 3, 2). After the root has been lubricated with petroleum jelly the die is fixed into the plaster impression

with a piece of matchstick cemented to the apex of the root part and to the side of the impression (*Fig.* 3, 4). When this impression has been poured in artificial stone and separated an accurate model of the root canal, root face,

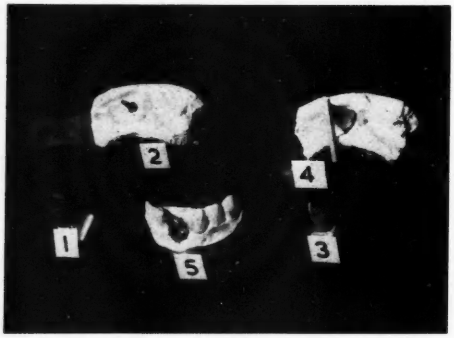


Fig. 3.—Photographs of impressions and models needed for making a post-retained crown by the indirect method.

Fig. 4.—Rubber-base impression of root canal, root face, and adjacent teeth which has been removed from its tray and sectioned so that the detail of the position of the impression of the root canal and the sharpness of that of the root face can be seen more easily.

and adjacent teeth is ready for use in the laboratory (*Fig.* 3, 5). Instead of copper-forming the die it could be made from amalgam or model Kryptex. The present writers, however, always use copper-formed dies because of their superiority over those made from the other materials.

The method of obtaining impressions of the root canal, root face, and adjacent teeth which has just been described makes use of the conventional green stick composition and plaster-of-Paris. Some operators have found this method exacting and would prefer one which is easier to carry out. The introduction of the rubber-base impression materials has enabled the writers to devise a simpler impression technique. An impression of the root canal is obtained in the same way as has already been described using green stick composition and 1-mm. German silver wire with about $\frac{1}{4}$ in. of the wire being allowed to project from the root face (*Fig.* 2, 4). This is either well serrated or bent in the form of a loop. With this still in position in the tooth (*Fig.* 2, 4) an impression is taken over it and the adjacent teeth with a rubber-base impression material. When the impression has set it is withdrawn. Because of the loop in the projecting part of the wire the impression of the root canal is also removed with it (*Fig.* 4). This impression is cast in a

Fig. 5.—Model obtained from rubber-base impression trimmed and mounted on a plaster base and then sectioned.

hard stone such as Q.S. Stonehard or Duroc and when set the impression material is removed from the model. This is then trimmed so that its base tapers away from the tooth so that when a second base in plaster-of-Paris is made to it after it has been coated with petroleum jelly, it can be removed. The model is then sectioned in the same way as is done for models obtained from hydrocolloid impressions (*Fig.* 5). The die of the root canal and root face is trimmed so that the periphery of the

face is exposed (*Fig.* 6) and then patterns are obtained from these models in a similar way to the method which has already been described when composition and plaster-of-Paris are used. Good results have been obtained with

Fig. 6.—Model of root face, and root canal trimmed so that the periphery of the root face is exposed.

Fig. 8.—Pattern of core mounted with its reservoir ready for investing.

this method, but it must be realized that copper models are superior to ones made from stone because they cannot be damaged while the patterns are being made and because the finished metal work can be polished and burnished on the model. The method which employs the rubber-base material, however, eliminates the fitting of a copper ring, which sometimes is difficult and time consuming. It has been found that the rubber-base materials are sufficiently rigid to enable a good impression inside the gingival crevice or parodontal pocket to be obtained without the need for depressing the gingival tissues with

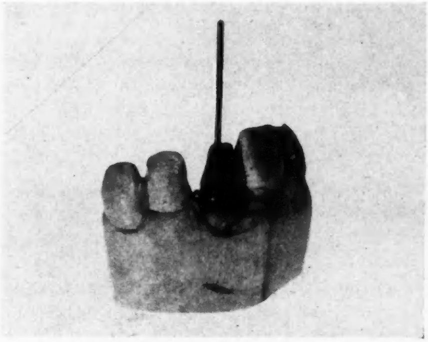


Fig. 7.—Wax carving of the core which will be cast in gold or chrome cobalt over which a jacket crown will be made.

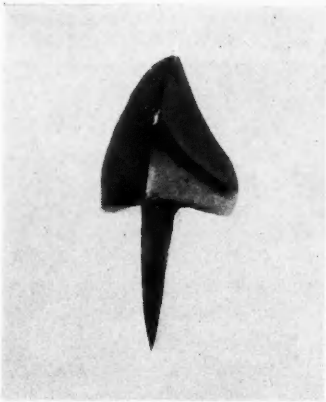


Fig. 9.—Acrylic-resin-faced crown with chrome cobalt post and backing.

packs or removal with the cautery before the impression is taken.

On the model just obtained (*Figs.* 3, 5 and 7) all the crowns to be described can be made by the technician, with a great saving of the dental surgeon's time, and the wax can be carved and the gold, acrylic resin, or porcelain trimmed more deliberately and thoroughly. The first type of crown to be described is one in which a core of gold is made to take a jacket crown

(*Fig.* 7). This enables a damaged crown to be repaired. The pattern for the core is obtained by selecting a piece of 1-mm. wire which is long enough to pass to the end of the root canal and is about ½ in. longer than the crown of the tooth. This is used in the same

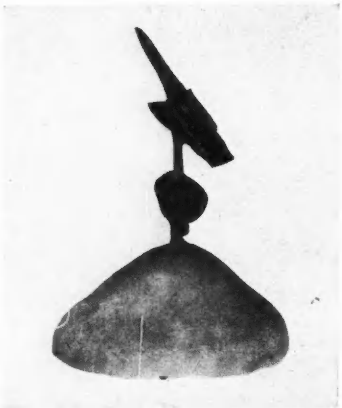


Fig. 10.—Steele's backing ready to be invested.

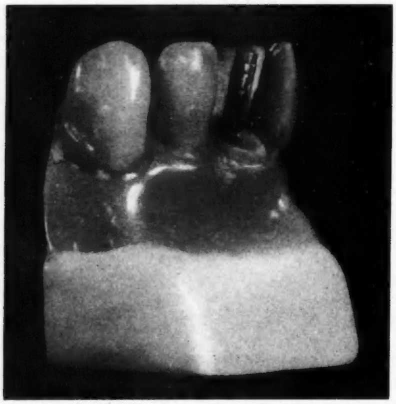


Fig. 11.—Steele's backing after it has been cast and fitted to the model.

way as for the taking of the original impression of the root canal so that a pattern of the root canal of the die is obtained. The pattern is cooled with cold water and removed so that it can be examined for accuracy. Minor discrepancies between the apical and the cervical part can be ignored. If it is satisfactory it is put back into the die, and over the projecting part of the wire is placed a piece of inlay wax stick about ¼ in. long through the middle of which a hole has been made with a piece of warmed German silver wire of the same gauge as that used in the preparation of the crown. The wax can now be carved to the shape of the conventional jacket crown preparation (*Fig.* 8). When this has been cast in gold and trimmed an acrylic-resin or gold-backed acrylic-resin or porcelain jacket crown can be made upon it.

Of the three types of crown the gold-backed acrylic-resin post crown has been used by the authors for some years and it has been found to be of good appearance and very durable. To make it a gold backing, a diaphragm, and gold post are cast in one piece in platinized gold, one of the palladium alloys such as "Pallacast", or in chrome cobalt (*Figs.* 9, 10). The support for the wax while it is being carved is a piece of the 1-mm. German silver wire shaped in the same way as for taking the impression. It must, however, be about ¼ in. longer than the crown of the tooth. When the

Fig. 12.—Steele's backing made from a plastic preformed backing ready to be invested.

root canal has been lubricated and filled with wax strip the warmed wire is fixed into it and the wax is run around its projecting part and carved in the form of a backing and a diaphragm, taking into account the occlusal relationship of the teeth recorded in the bite (*Fig.* 10). Retention for the acrylic resin facing is obtained by undercutting the labial surface

of the backing which is extended up to the incisal edge of the facing. Where there is superior protrusion or inferior retrusion a better æsthetic effect can be obtained by extending the backing only up to the cingulum area of the crown (*Fig*. 1, B, C). If the patient does not object to the appearance of gold at the cervical part of the crown the diaphragm can be extended to the labial extremity of the root face (*Fig*. 9). This provides a fitting surface entirely of gold or chrome cobalt and eliminates the possible leaking which might occur if the margin is sealed with acrylic resin alone. If, however, the patient does not like gold in the front of the mouth the labial fitting edge can be restored with acrylic resin.

Although chrome cobalt does not seem to have been used in crown work before, the writers have succeeded in making satisfactory backings, posts, and diaphragms from this metal. The advantages obtained from using chrome cobalt are the low specific gravity (half that of gold), lower price, and hardness (Brinell hardness for chrome cobalt 290 and gold 100). In those cases where the forces of mastication are abnormally strong backings made from chrome cobalt should prove to be useful.

If a crown of the type just described is damaged and is to be repaired with heat-polymerized acrylic resin the whole crown must be removed. As this is often difficult it is more convenient to carry out the repair with self-polymerizing acrylic resin. Repair of the Steele's type of facing is easy and within recent times acrylic resin facings of this kind have become available. Gold or plastic backings are supplied with them. The plastic backings can be waxed up to the pattern of the root canal and cast in gold (*Fig*. 11). Crowns of this type have proved difficult to construct in the first place, and the method adopted when gold backings are used is to make crowns in two parts and then to solder the backing to the cast diaphragm and post. When the plastic backings are used they may be waxed together with the pattern of the root canal and diaphragm (*Fig*. 12) and cast in one piece. For this process self-polymerizing acrylic resin may be used instead of wax, and although it has been pointed out by McLean and Morrant (1954) that acrylic resin is not a good substitute for wax, some successful crowns have been made in this way.

SUMMARY

Three types of crown have been described employing a post which fits the root canal accurately and which is so constructed that it does not rotate during mastication. Two of the crowns can easily be replaced, while the third can be repaired with self-polymerizing acrylic resin. These crowns are not worn away by attrition and those having a diaphragm which covers the root face are superior to those which rely for their marginal seal on acrylic resin which shrinks and flows. All methods are indirect, which means a saving of time for the dental surgeon and enables more careful shaping of the restorations.

Acknowledgements.—The writers wish to thank Mr. B. Wilkinson and Mr. R. Coussins for their help in preparing the models and photographs.

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Lawton, F. E., and Myers, G. E. (1951), *Brit. dent. J.*, **91**, 181.

McLean, J. W., and Morrant, G. A. (1954), *Ibid.*, **97**, 59.

Johnson, Wesley, and Matthews, E. (1948), *Ibid.*, **85**, 245.

Mechanical Principles in Extra-oral Anchorage

The equipment for distal movement of upper or lower molars, or both, with control of tipping factors, consists of a nylon net head-cap to which hooks are fastened, an extra-oral yoke, and an intra-oral bow or "Y" bar.

A tube on the extra-oral yoke engages and will rotate about the anterior shank soldered to the intra-oral bow.

Adjustments of the apparatus to achieve various combinations of rotatory movement, with intrusive or extrusive force, are described.—Gould, I. E. (1957), *Amer. J. Orthodont.*, **43**, 319.

THE VALUE OF ULTRA-VIOLET LIGHT IN MACROSCOPIC EXAMINATION OF TEETH

By **K. P. DURKACZ**, M.D., L.D.S., and **S. F. MGLEJ**, Vet. Sc.D., Vet. Med. D.

THIS is an attempt to describe the main features of the appearance of teeth under the ultra-violet light. Freshly extracted teeth and dry specimens were used. It was sought to find out any difference which may be due to disease and age. Only the macroscopic aspect was taken into consideration, with the clinical bearing wherever possible. The early carious lesions, otherwise difficult to detect, are easily discernible in ultra-violet light. Also carious dentine in the walls of a prepared cavity shows as a darker patch.

The following data, available with the extracted teeth, were noted:—

1. Age of patient;
2. Condition of the surrounding gum;
3. Antiseptic used for sterilization of gum prior to extraction;
4. Whether the tooth was judged vital or pulpless at the time of extraction.

We have examined 940 human teeth, including 302 freshly extracted teeth. There were also 130 animal teeth, including those of dogs, cats, rats, and rabbits. No attempt was made to investigate the appearance of teeth directly in the patient's mouth, although this may be attempted in the future, particularly since the 'Fluoretor' is especially suited for this purpose.

MATERIAL AND METHOD

Freshly extracted specimens were examined under the ultra-violet light. To achieve uniformity of observation, the source of ultra-violet light ('Fluoretor' with a theoretical range down to 2800 Å, fitted with a Wood's filter—actual range used 3500–3000 Å) was allowed to heat for 2 min. All observations were made in a darkroom. The examined specimens were first washed and scrubbed under the tap. When dry, all the adhering periodontium was scraped off from the roots. Some specimens were afterwards polished on a lathe. For comparison, freshly extracted teeth of animals were included in this series as a separate group. Dry specimens used were 1–2 years old. The freshly extracted dog teeth were obtained by the courtesy of the Royal Dick Veterinary College. Opportunity for the limited bacteriological study was also by the courtesy of the Royal Dick Veterinary College.

An attempt was made to find the effect of immersion of teeth in diluted acids. For this purpose teeth were immersed in 1 per cent HCl and 1 per cent H_2SO_4 solutions for 24 hours. No change in fluorescence was observed. The teeth were then left in these solutions for 2, 4, and 6 days, without any appreciable change being observed. When kept longer than 6 days in these solutions diminution of fluorescence was observed. The animal teeth generally show the same characteristics under ultra-violet light as the human teeth. It was noticed, however, that dog calculus deposits were all strongly fluorescent, showing a reddish or brown hue, while cat calculus was inclined to be orange-pink. Most of the rabbit teeth showed very poor fluorescence, slightly greenish in colour. Rats' teeth were somewhat similar to those of rabbits. One group of 115 human specimens was boiled for from ½ to 2 hours after a preliminary examination for fluorescence. A slight diminution of brightness of fluorescence was found after boiling, affecting both the crown and root. Fresh teeth were used as controls.

LITERATURE

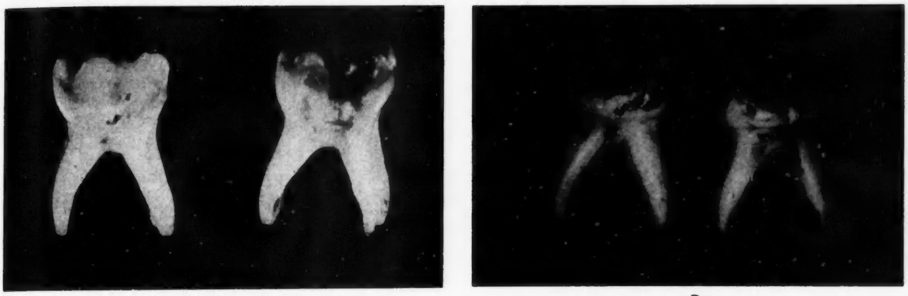
Fluorescence is the property of certain materials to produce visible light under the impact of invisible ultra-violet radiation. The colour and intensity vary with the material under examination. This fact has been well recognized for many years, and advantage was taken of it in numerous fields, notably: industry, medicine, criminology, etc. Recently it has been adapted to microscopical examination (Hals, 1953 a), and has proved of extreme value in other fields, in determining minute

quantities of certain chemicals the detection of which by other means would be very laborious.

The general appearance of extracted teeth under the ultra-violet light was described recently by Hartles and Leaver (1953, 1955). They give a very accurate account, but their main concern is with the chemical identification of the fluorescent factor. Dickson, Forziati, Lawson, and Schoonover (1953) working on behalf of the American National Bureau of Standards have developed a technique of examination of ground tooth sections under the ultra-violet light. This, according to Dickson, brings out more clearly various details of the structure of the teeth than the ordinary light. Extensive chemical and microscopical investigations of Hals (1953 b) prove the value of fluorescence as a tool in this field. Folstein (1952) described the clinical application of fluorescence for examination of teeth and other mouth structures.

RESULTS AND DISCUSSION

The healthy enamel shows a brilliant bluish fluorescence, marred only by the presence of natural fissures and pits. This fluorescence is only slightly less intense in deciduous teeth. All chalky areas on enamel show darker in ultra-violet light. All carious lesions of dentine appear dark, but in many of them streaks and patches of yellow or gold fluorescence can be seen. When all caries is excavated, there is invariably a brownish-yellow or orange fluorescence of the hard dentine forming the bottom of the cavity. This does not seem to depend on whether the caries was treated or not, and is similar to cases in which an old amalgam filling was removed from the extracted tooth in order to expose the dentine for the purpose of examination. Any carious dentine left in such a cavity can be easily seen as a darker patch (possible clinical application?). Fluorescence of cementum is perhaps less intense, but there is always a slight yellowish tinge. We



A B

Fig. 1.—Deciduous molars under A, Ordinary light, B, Ultra-violet light. Carious and decalcified areas show dark in B. The apical one-third described in the text does not show well in this photograph.

Table I.—Distribution according to Age of the Freshly Extracted Human Teeth showing Difference in Fluorescence of the Root

Age Group	3–10	10–20	20–30	30–40	40–50	50–60	60+
Number of teeth showing bright fluorescence of the apical one-third of root	0	0	0	0	18	39	28
Number of teeth showing darker appearance of the apical one-third of root	40	43	61	64	9	0	0
Total number in each group	40	43	61	64	27	39	28

Total number of teeth examined—302.

have noted a difference in the intensity of fluorescence of cementum according to age: Cementum of the deciduous teeth and those of persons up to about 40 years old (*Table I*) shows a definite darkening of the one-third of the apical part of the root. In older people the apical one-third appears lighter in colour (*Fig.* 1). On longitudinal section the fluorescence of enamel appears brighter than that of dentine and cementum.

Since some of the filling materials show brilliant fluorescence, it was decided to mention the appearance under the ultra-violet light of the commonly used cements. Most of the filling cements show fluorescence, and with some of them it is very brilliant. It appears that in cavities without any lining the silicate cements leave traces of pink fluorescence in underlying dentine still visible after filling is removed and the walls scraped thoroughly with excavators.

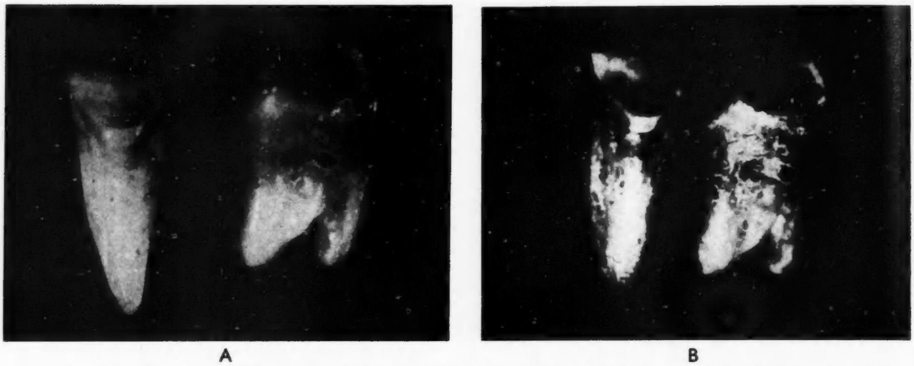


Fig. 2.—Freshly extracted human teeth (age 60). A, Ordinary light; B, Ultra-violet light. Heavy subgingival calculus. Greenish fluorescence clearly visible in ultra-violet light. Cement filling in the incisor tooth shows pink fluorescence. Note bright fluorescence of the apical one-third of the roots.

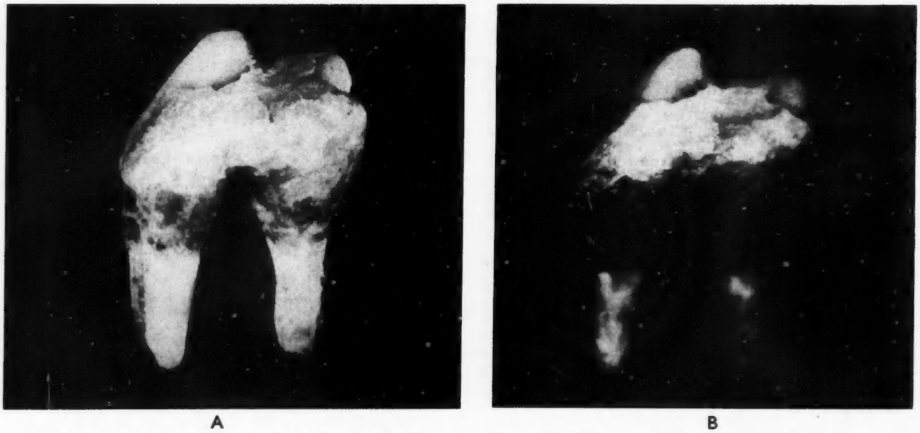


Fig. 3.—Collie dog, aged 14. A, Ordinary light; B, Ultra-violet light. Heavy calcareous deposit, deep red-brown fluorescence. Apical one-third of the roots fluoresces brighter than the rest of root, much the same as in an aged human.

Surfaces of teeth subject to attrition, and the cervical erosion areas, appeared slightly greenish and as a rule were darker than other parts of the tooth. This observation appears to contradict the description given by

Folstein (1952), who, viewing the teeth *in vivo*, describes those areas as bright. Pulpless teeth of long standing show greenish fluorescence of the roots and pinkish colour of the crowns.

The roots of teeth extracted in cases of deep pocketing and advanced pyorrhœa with deposits of serum calculus usually show greenish fluorescence with an obvious salmon-pink colour of concretions (*Fig*. 2). On some, quite unexpectedly bright golden-yellow patches were seen. It was impossible to establish what these were due to, and consequently it is suspected that some outside contamination may be responsible although why this should occur only in this group we cannot tell. Heavy calcareous deposits seen on some dogs' teeth had very distinct reddish fluorescence (*Fig*. 3). This was found to be so different from all human calculus that it was thought proper to mention it here.

Since a particularly strong fluorescence of all calcareous deposits was noticed, quite apart from fluorescence of enamel, dentine, and cementum, it was thought advisable to attempt a limited bacteriological investigation. For this purpose calculus, both gingival and subgingival, was detached from the freshly extracted teeth and crushed in sterile saline. This was used to inoculate plain agar, blood-agar, and broth, all of which were then incubated for 48 or 72 hours and examined under ultra-violet light. Profuse growth was obtained in all cases. No fluorescence whatever was noticed on some 21 plates and other cultures. Carious dentine was also treated in the same manner, as well as apices of frankly infected teeth, but no fluorescence of colonies was detected in either case.

SUMMARY

An attempt is made to describe the appearance of extracted teeth under ultra-violet light. Imperfections of the enamel surface and carious lesions show clearly as non-fluorescent areas. This may have possible clinical application. Difference in fluorescence of young and old teeth is commented upon. This is no doubt due to the degree of calcification present. Calcareous deposits have their own peculiar fluorescence. So far it is impossible to say if the strong fluorescence of tartar is due to its inorganic composition or is the result of bacterial action.

Our thanks are due to Mr. W. W. Gregor, M.R.C.V.S., of the Veterinary Medicine Department of the Royal Dick Veterinary College for the supply of dogs' teeth. We also wish to express our thanks to Mr. G. E. Phillips, M.R.C.V.S., from the Veterinary Bacteriology Department, for affording us facilities for bacteriological investigation.

The source of ultra-violet light, the "Fluoretor", used in this work was kindly lent by Menlo Research Laboratories, California.

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Histochemistry of Calculus Formation

The early stages of calculus formation were studied by placing celluloid strips around the mandibular anterior teeth on patients known to form calculus rapidly.

These strips were removed at intervals of 2–29 days, and fixed in section without prior decalcification. It was found that various filamentous micro-organisms, among which could be identified *Actinomyces Israeli*, formed the ground substance, although the presence of many coccoid forms, rather than filaments, in the earlier states raised the question of the mode of attachment of the matrix or plaque to the strips on the tooth surfaces. At times it appeared that attachment could take place in the absence of filamentous forms. A cuticle was frequently observed, which was similar to that found on the enamel or cementum.

With the onset of calcification there appears to be a partial loss of metachromasia and a marked diminution in the intensity of the Schiff reaction.—MANDEL, I. D., LEVY, B. M., and WASSERMAN, B. H. (1957), *J. Periodont.*, **28**, 132.

A STUDY OF THE GROWTH IN HEIGHT OF THE ALVEOLAR PROCESS: O'MEYER'S SIGN*

By **R. X. O'MEYER**, *Paris*

FACIAL growth has been an extensive field of investigation during the last thirty years, that is, since the coming of teleradiography and the perfecting of it by Broadbent.

Anatomists and anthropologists have been concerned with this subject, but more from its ethnical standpoint than its additional stages.

The author has recalled the history of the research carried out in the course of time on facial and alveolar moulding (O'Meyer, 1954). Certain opinions have been, and still are, divergent with regard to utilizing and interpreting the information contributed by cephalometry, but to deny or dispute the value of the works of Ballard, Broadbent, Brodie, Downs, Hovell, Ricketts, Rix, Steiner, Thompson, and others would be going rather far into the field of scepticism.

While we may not be always absolutely certain about the mathematical value of cephalometric measurements, they come very near to the truth, and I think that any error comes from the human side. During a recent discussion at the Société Française d'Anthropologie, I recalled the precautions taken by Brodie during the research work that he carried out on facial and cranial growth: (1) On dry skulls, the positioning of metal sighting marks on the anthropological points and those used in orthodontia; (2) Metric measurements of the distance between the various points; (3) The taking of teleradiographic films and measurements between the points previously considered.

The margin of error was insignificant.

We know the various chronological stages of growth in general. Facial growth may be considered to resemble a tree where the growth is characterized by large stages and seasonal periods, the latter being capable of being divided up into six parts:—

1. Infancy (birth–3 years);
2. Second infancy period (3–6 years);
3. Third infancy period (6–10 years);
4. Pre-pubescent and puberty period (10–14 years);
5. Post-pubescent period (14–17 years);
6. Nubility (17 years–maturity).

Slight variations correspond to all these periods according to the sex under consideration, the region studied, and the presence or otherwise of orthodontic treatment. Farther on we shall observe the importance of those various factors. The elements forming facial structure are multiple, and their growth does not appear in synergy. If we consider the upper part of the face, we observe that the eyes and the nasal fossæ fulfil their function right from birth, whereas the lower part, characterized by the mandible, only starts up much later and is partially dependent on dental eruption. That is why mandibular growth seems to be more active than maxillary growth, which is motivated by the slowness exhibited by the mandible during fœtal life.

Out of all this assembly of bone growth we shall confine our investigations to alveolar growth.

WHAT IS THE ALVEOLAR PROCESS?

Black (1902) defined the alveolar process as: "The bone projection which grows around the roots of the teeth and forms the cavities in which their roots are secured by their ligament." John Hunter gave the similar definition, when he wrote:

> "The alveolar processes of both maxillaries should rather be considered as belonging to the teeth than as parts of the jaws; for they begin to be formed with the teeth, keep pace with them in their growth and decay and entirely disappear when the teeth fall; so that, if we had no teeth it is likely we should have no sockets, but not even these processes in which the sockets are formed; and the jaws can perform that function and give origin to muscles without either the teeth or alveolar processes. In short, there is such a mutual dependence of the teeth and alveolar processes on each other that the destruction of the one seems to be always attended with that of the other."

* A paper read at the meeting of the British Society for the Study of Orthodontics, held on March 11, 1957.

Ever since Hunter wrote the above in 1771 there has been controversy over whether the alveolar processes should be considered as part of the jaws. Anatomically, no distinct boundary exists between the body of the maxilla or mandible and their respective alveolar processes.

"In some places the alveolar process is fused with and partly masked by bone which is not functionally related to the teeth. In the anterior part of the maxilla, the palatine process is fused with the alveolar process. In the posterior part of the mandible the mylohyoid bone line is superimposed upon the bone of the alveolar process." (Orban, 1944.)

Brodie (1934 a) wrote:—

"At birth, the face has the following appearance: the hard palate or floor of the nasal fossæ is at a level slightly below the orbital floor. The orbital cavities are well developed in size and their floor literally forms the base of the alveolar process. At this stage, the latter is only shown by a ridge surrounding the hard palate, and the maxillary sinus is a simple groove situated close to the lateral wall of the nasal cavity. In this confined spot, limited above by the orbital floor, in the middle by the nasal wall and below by the alveolar fissure, there lie, close to each other, the germs of all the teeth of the maxillary, with the exception of the second and third permanent molars.

"The growth of the alveolar processes contributes far more to the length of the face than all the other factors. The bone is widely extended over the crest and on the lateral surface of the process and is speedily converted into spongy bone, so that this bony area forms a continual centre of activity during the growing period."

This would appear to be confirmed by what MacMillan (1924 a, b) stated:—

"The alveolar process varies with the length of the cuspids, the angles and inclined planes, the axis of the forces, the loss of teeth, the masticating forces, etc.... and all these factors are in their turn in relation with the shape of the glenoid cavity and the condyle."

Continuing his research work, the same author observed in 1927 that an abnormal alveolar process might correspond to closing surfaces showing a certain degree of abrasion. Commenting on the individual relative proportions of long and short faces, Brash (1924) wrote:—

"It is evident that the principal factor in differentiating between these two extreme types of face, may be found in the increase of growth in length, with an increase of the proportions of alveolar bone."

With the same ideas in mind Sicher and Weinmann (1947) wrote:—

"Downward and forward growth of the sub-nasal part of the maxillary is accompanied by an intensive affixing of bone in this area and contributes, not only to the increase in length of the upper facial framework, but also enables the normal adjustment of the alveolar process with the dental arch, which is specially necessary at the time when dentition changes."

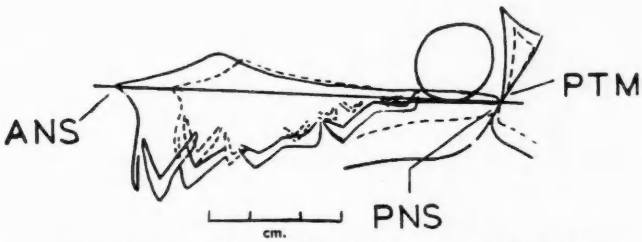

Fig. 1.—Diagram to show growth of alveolar process and fixed points.

Brabant (1955) shows that:—

"The bony bridges direct themselves according to the best principles of architecture for shouldering the alveolar edges. When the canine teeth erupt, the external table thickens opposite to them, whereas the base of the column thus formed widens. The eruption of the molars is accompanied by a strengthening of the cheek-bone and tuberosity: the maxillary sinus, which is very small in the child, then attains to its final expansion. The modifications of the alveolar processes are still very much more important. They continue throughout the duration of final dentition, in spite of fixing the term of bony growth at six years."

Ortiz, in his thesis (Ortiz and Brodie, 1949), observed:—

"At birth the alveolar process is practically non-existent and its inferior surface lies only slightly below the level of the palate. The pterygoid process descends to this same level at its junction with the maxilla, while its inferior border runs downward and backward so that the hamular process at its postero-inferior extremity is carried to a still lower level. . . . From birth onward the alveolar process descends at a much higher rate than does the pterygoid process." (*Fig.* 1.)

We will now observe how the alveolar bone behaves during facial growth. We can perceive that this bone develops in three dimensions.

Brabant says:—

"In length, it converts the profile of the child by lengthening the lower part of the face. Its widening, which is not very marked on a level with the milk molars

because they are replaced by smaller premolars, may reach, on a level with the incisors, 30% of the primitive width. In length, the eruption of the molars, helped by a powerful mesial movement, will cause an appreciable change in the alveolar edge."

In the general opinion of research workers from John Hunter to the present day, the process of replacing milk teeth is associated with the destruction of the alveolar process which sustains them and the eruption of the permanent teeth testifies to the construction of a new alveolar process.

To show this by starting with telecephalometric examination has been the object of the research work that I have undertaken.

METHOD EMPLOYED

The various points, lines, planes, and angles employed are illustrated in *Fig.* 2.

The anterior nasal spine (ANS) is easily ascertained and located, but the posterior nasal spine (PNS) may be hidden in certain pictures by a tooth in the course of formation or about to erupt; although in many cases the floor of the nasal fossæ is visible from one end to the other of its extent, in doubtful cases we can locate PNS by basing it on the attaching point to the soft palate.

With regard to the mandible, the profile is usually clear and distinct and it is only necessary to determine which points we shall utilize for making quantitative measurements.

The gnathion (Gn) is obtained by bisecting the angle formed by the tangent lines, one at the most deviated point, the other at the most projecting point of the mental symphysis. Assuredly this is an arbitrary point, but it is constant and more easily located than a hypothetic gnathion.

The determining of the gonion (Go) is obtained by bisecting the angle made by the tangent lines at the posterior and lower edges of the junction of the mandibular body with the ramus.

When two pictures appeared, which is almost the rule, the mean was utilized.

Each radiographic examination of the head, of all the series, was drawn on fine acetate paper with a hard pencil.

Very special attention was paid to the maxillary part placed under the floor of the nasal fossæ and for the mandibular body, because these areas form part of the dental field.

The following points and planes were drawn up for taking the measurements (*Fig.* 2).

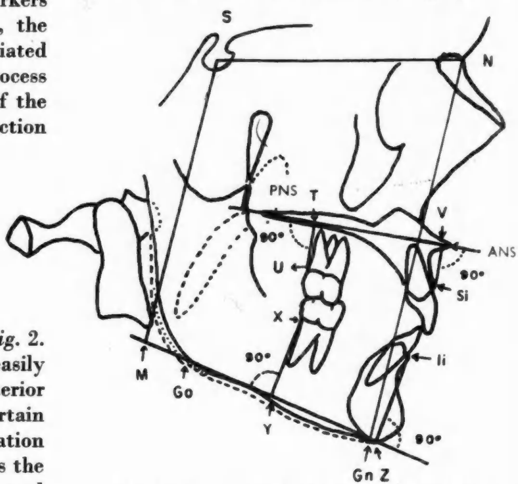

Fig. 2.—Tracing made from lateral headplate, showing the various points and areas studied in this investigation.

Explanation of Abbreviations used in the Text and Illustrations.—

Points:

ANS, End of anterior nasal spine;

Gn, Lowest point on silhouette of mandible at symphysis;

Go, Point of bisection between most inferior and posterior points on angle of mandible;

Li, Crest of alveolar process at lower central incisor;

M, Point of intersection of line dropped from S intersecting plane Gn–Go and parallel to N–Gn;

N, Fronto-nasal junction;

PNS, End of posterior nasal spine;

S, Centre of sella turcica as located by inspection;

Si, Crest of alveolar process at upper central incisor;

T, Point of intersection of perpendicular from U to plane ANS–PNS;

U, Crest of alveolar process distal to upper first permanent molar;

V, Point of intersection of perpendicular from Si to plane ANS–PNS;

X, Crest of alveolar process distal to lower first permanent molar;

Y, Point of intersection of perpendicular from X to plane Gn–Go;

Z, Point of intersection of perpendicular from Li to plane Gn–Go.

Planes:

ANS–PNS, Line connecting anterior and posterior nasal spines and representing nasal floor;

Gn–Go, Line from Gn to Go representing lower border of mandible.

All measurements were read with correctional scales; where right and left images did not exactly superimpose the measurements were made to the point of bisection between them.

The height of the alveolar process was measured in four areas, viz.:—

1. Upper central incisor (Si–V);
2. Lower central incisor (Li–Z);
3. Upper first molar (U–T);
4. Lower first molar (X–Y).

Total anterior dental height was read between V and Z and total posterior dental height between points T and Y. Total anterior facial height was read between N and Gn and total posterior facial height between S and M.

This study was restricted to that period beginning with the eruption of the first permanent molar and the permanent central incisor. X rays of the period covering the eruption of the deciduous dentition, although revealing the teeth clearly, were not similarly reliable in the delineation of the alveolar crest which it was desired to study.

Several cephalograms on the eruption period of milk teeth were rejected, for, while the teeth were generally visible, the alveolar processes were not.

There is nothing of interest to report posterior to the deciduous molars. This area gradually accommodates itself for the eruption of the first permanent molars.

On the other hand, the change that accompanies the falling out of the temporary incisors and their replacement by permanent teeth is most interesting. In that area there is a distinct reduction in the height of the alveolar process to be seen before the central deciduous incisor falls out.

That is why the measurements of the molar and incisor area were taken just before replacement commenced.

The extent of the variation in age was so great when falling out had commenced that synoptic tables were drawn up according to the years of eruption taken as basic age, zero being the point where reabsorption had reached its extreme limit and where the growth of the alveolar process upwards recommences its reconstruction. The measurements before that stage are marked with a minus sign.

FINDINGS

As would be expected during this period of life, all dimensions measured showed increase. Certain sex differences were also differences found between treated and non-treated cases.

Table I.—Sex Differences

Sex	Alveolar Process	Increase		Decrease	
		Mean in mm.	Mean in mm.	Mean in mm.	Mean in mm.
M.	Lower post.	7·5	2–13	—	—
F.	Lower post.	4·5	2–7	—	—
M.	Upper post.	11·5	6–17	—	—
F.	Upper post.	10·5	5–14	—	—
M.	Lower ant.	8·0	4–11	2	1·0–3
F.	Lower ant.	6·0	4–10	3	1·5–4
M.	Upper ant.	5·5	1–10	3	1·0–10
F.	Upper ant.	6·5	3–12	5	2·0–7

We know that the skeleton undergoes the influence of sexual hormones, the face and the cranium not developing at the same rate with a girl as with a boy, and finally showing small morphological differences (Brabant).

Sex Differences.—Growth in height of all parts of the alveolar process is definitely greater in the male. The total increase in anterior dental height of the female for the mean of the sample was 6·95 mm., while the males exhibited a growth of almost twice as much, viz., 12·71 mm. Similar, but not such great difference, was noted in posterior total height, the females increasing 11·44 mm. and the males 15·89 mm. It will be noted that both sexes showed the gain in total posterior height to be greater than total anterior height.

Turning to specific areas (*Table I*), it was found that the male exceeded the female values everywhere except in the upper incisal region, where the mean female value was 6·5 mm., with a range of 3–12 mm., while the mean value male increment was 5·5 mm., with a range of 1–10 mm. The mean values for lower anterior and upper posterior heights were not greatly different—male 8 mm., female 6 mm. and male 11·5 mm., female 10·5 mm. respectively. The ranges were quite similar.

The greatest difference was noted between the sexes in the lower posterior region where the males yielded a mean of 7·5 mm. as against 4·5 mm. for the females. The range of this measurement was considerably greater in the male than in the female, however.

The greatest number of cases studied did not extend beyond the sixteenth or seventeenth year of life and at these ages all were still growing. A few cases for which records were available to the twenty-first year showed limited growth to that age. These were all males and therefore it was impossible to determine whether there were sex differences at the time at which growth ceased.

Differences in the Value of Growth.—In the boy, as in the girl, the difference observed in the value of growth was extremely great. In some cases the alveolar crest showed a steady increase in height from one end to the other of the period studied.

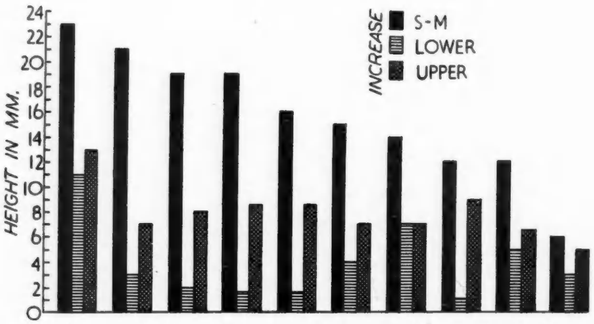

Fig. 3.—Diagram showing relative increase in posterior alveolar height, upper (T–U) and lower (X–Y) and total posterior height (S–M), in the female. Data arranged in order of decreasing magnitude of S–M show lack of correlation.

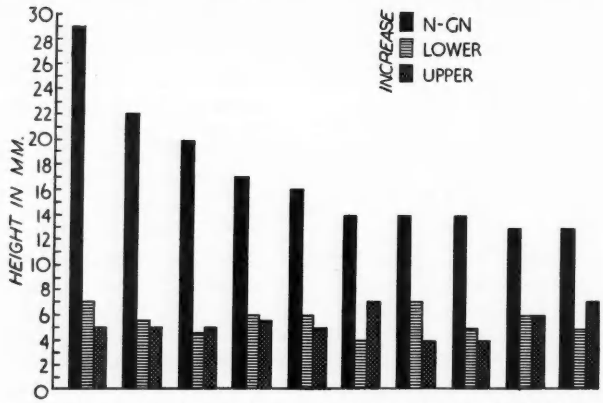

Fig. 4.—Diagram showing relative increase in anterior alveolar height, upper (V–Si) and lower (Z–Li) and total anterior height (N–Gn) in the female. Data arranged in order of decreasing magnitude of N–Gn show lack of correlation.

In other cases growth increased by 1–2 mm. after the complete eruption of the teeth. It was by analysing these data that we were able to establish a correlation with the difference in quantity of the total growth of the face in length, but a correlation of this kind proved to be really vague. This is to be regretted, for it might have enabled the question to be solved of knowing to which parts growth

exactly belonged quantitatively in the length of the face.

The following diagrams show the relative growth of the masculine and feminine alveolar anterior 6 mm., posterior 4·5 mm.; Male, lower anterior 8 mm., posterior 7·5 mm. The range was about the same in both as will be seen in *Figs.* 6–9.

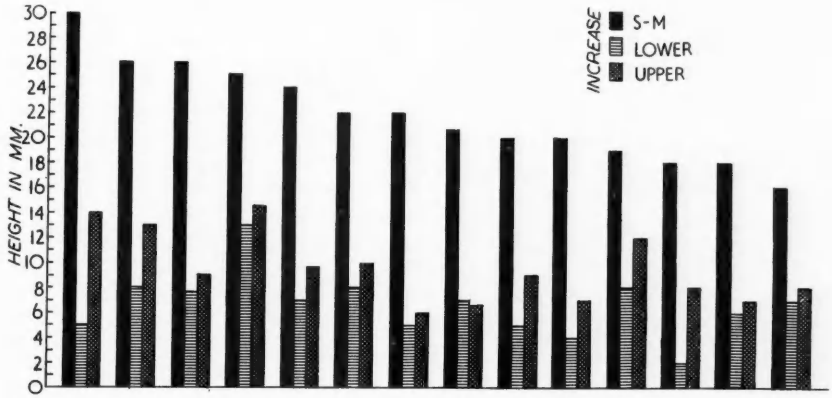

Fig. 5.—Diagram showing relative increase in posterior alveolar height, upper (T–U) and lower (X–Y) and total posterior height (S–M) in the male. Data arranged in order of decreasing magnitude of S–M show lack of correlation.

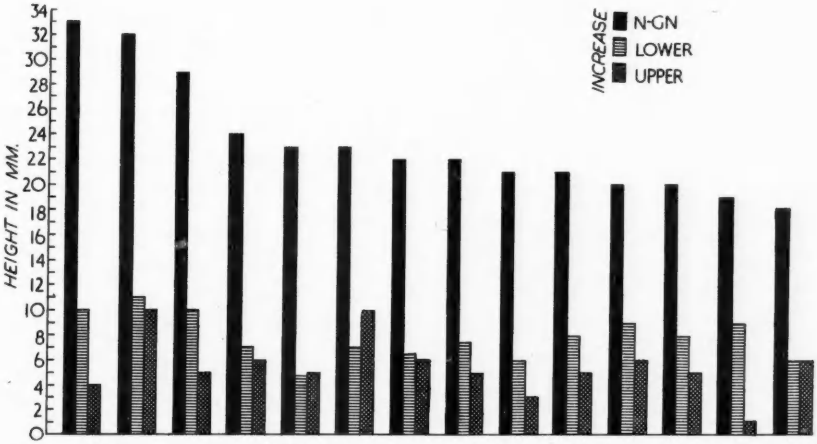

Fig. 6.—Diagram showing relative increase in anterior alveolar height, upper (V–Si) and lower (Z–Li) and total anterior height (N–Gn) in the male. Data arranged in order of decreasing magnitude of N–Gn show lack of correlation.

processes in the areas studied (*Figs.* 3–5).

Differences of Localization of Growth.—In both males and females the vertical increase in the lower anterior region was greater than that in the lower molar area: Female, lower

In the maxillary readings just the opposite was true, the molar height increase in both sexes being higher than the anterior increase: Female, anterosuperior 6·5 mm., posterosuperior 10·5 mm.; Male, anterosuperior

2

5·5 mm., posterosuperior 11·5 mm. (*Figs.* 10–14.)

This supports recent findings on the growth behaviour of the total pattern of the facial

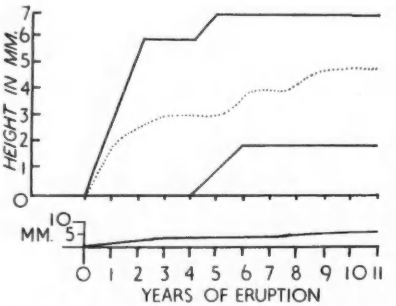

Fig. 7.—Graph of mean and total range of sample of growth in lower molar area (female). Low curve shows actual mean increment in mm.

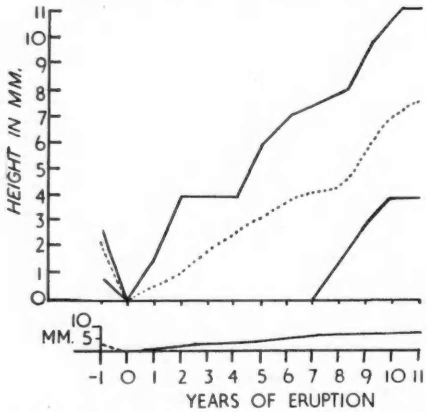

Fig. 9.—Graph of mean and total range of sample of growth in height of alveolar process in lower molar area (male). Low curve shows actual mean increment in mm.

growth (Brodie, 1948, a or b; Bjork, 1951) that the posterior end of the occlusal plane tends to drop with age.

Differences in Time.—Here again differences were found and they seemed to reflect sex differences as well as individual variation (*Table II*).

Variation in the time and order of eruption of the teeth has long been recognized, but we have been able to find no reference to any correlation that might exist between this phenomenon and the amount of alveolar growth. The present study indicated that teeth which erupt early were associated with

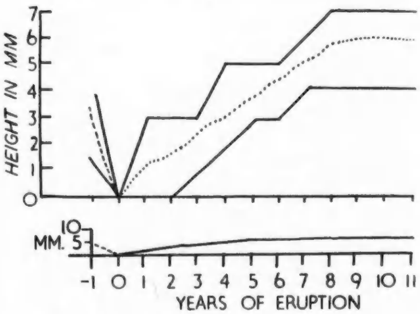

Fig. 8.—Graph of mean and total range of sample of growth in height of alveolar process in lower process in lower anterior area (female). Low curve shows actual mean increment in mm.

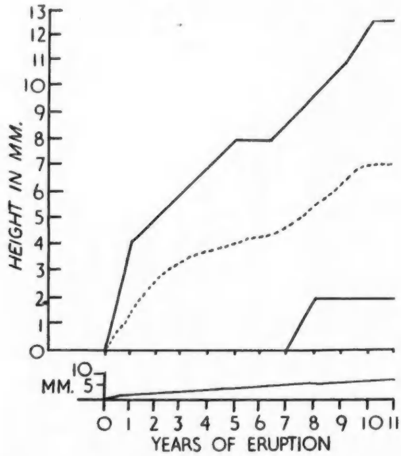

Fig. 10.—Graph of mean and total range of sample of growth in height of alveolar process in lower anterior area (male). Low curve shows actual mean increment in mm.

average or better growth of the process, while those erupting late showed slow and limited growth.

Discoveries of interest were made about the loss in height of the alveolar process at the time when the deciduous teeth were replaced by the permanent ones.

This phenomenon had already been remarked upon by research workers since John Hunter, but to my knowledge there had not been any measurement taken up till now.

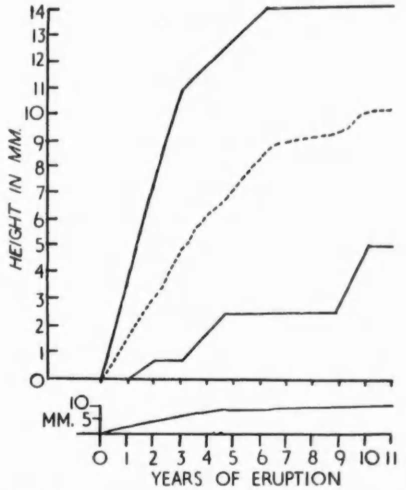

Fig. 11.—Graph of mean and total range of sample of growth in height of alveolar process in upper molar area (female). Low curve shows actual mean increment in mm.

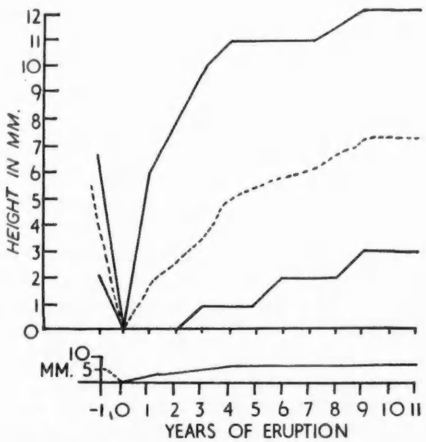

Fig. 12.—Graph of mean and total range of sample of growth in height of alveolar process in upper anterior area (female). Low curve shows actual mean increment in mm.

According to the obvious results given by radiographic examinations it is evident that the loss in height of the alveolar process coincided with the resorption of the root of

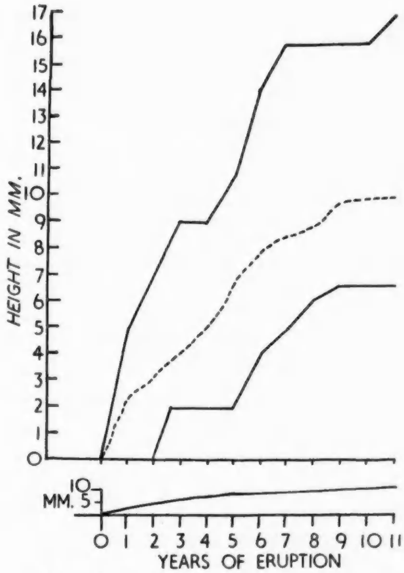

Fig. 13.—Graph of mean and total range of sample of growth in height of alveolar process in upper molar area (male). Low curve shows actual increment in mm.

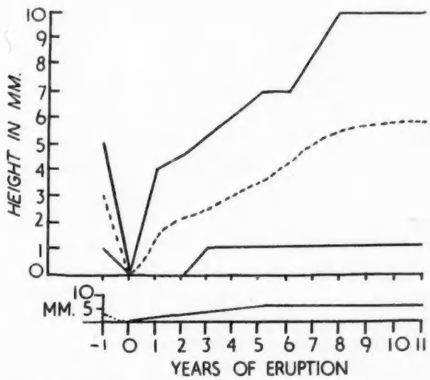

Fig. 14.—Graph of mean and total range of sample of growth in height of alveolar process in upper anterior area (male). Low curve shows actual increment in mm.

the deciduous tooth; the alveolar bone is attacked near its crest and portions may be cut off in the form of small sequestra (*Fig.* 15).

is this not made up by eruption

The loss in height thus sustained may be as much as 7 mm. This decrease is shown in *Figs.* 7, 9, 11, and 13, where the bottom of the curve represents the beginning of rebuilding of the process, regardless of age. The same curve shows that four or five years on the average is required to rebuild the process to its previous height. The process of destruction and rebuilding of the alveolar process probably occurs in the case of all of the succadaneous teeth. There would seem to be no need for it in the case of the molars and none was shown by measurements.

Table II.—Increase in Height of the Alveolar Process (Non-treated Cases)

Years of Eruption	Upper Anterior No.	Upper Anterior mm.	Upper Posterior No.	Upper Posterior mm.	Lower Anterior No.	Lower Anterior mm.	Lower Posterior No.	Lower Posterior mm.
MALE								
− 2								
− 1	10	−3·1			2	−2·5		
+ 1	4	9·5	14	3·7	12	27	13	19·8
+ 2	11	13·5	14	6·5	14	26·6	13	22·5
+ 3	12	13·7	12	7·6	12	27·6	12	21·8
+ 4	14	13·8	13	7·6	14	28·1	14	22·1
+ 5	12	15	12	9	12	28·3	12	23·2
+ 6	14	15·7	14	9·7	14	29·2	14	23·2
+ 7	14	16·2	13	10·8	14	30·3	13	23·3
+ 8	13	13·8	12	12·4	10	30	11	26·2
+ 9	10	16·1	10	13·2	13	31·8	12	26·4
+10	8	16·6	8	13·7	8	32·2	9	25·3
+11	14	17·6	9	15·2	10	34·5	9	27·2
FEMALE								
− 2	1	−2						
− 1	6	−5			4	−2·8		
+ 1	5	10·5	7	3·4	8	3·4	8	18
+ 2	9	11·6	9	5·1	9	27	9	19·3
+ 3	10	12·5	10	7·2	10	26	10	21·8
+ 4	10	13·2	10	8·5	10	26·9	10	20·2
+ 5	10	14·3	10	9·5	10	27·7	10	20·4
+ 6	8	14·4	8	10·8	8	25·1	8	20·6
+ 7	8	15	8	12·2	8	29	8	22·1
+ 8	10	15·1	10	11·3	10	29·5	10	21·3
+ 9	9	15·3	10	12·8	10	29·6	9	21·6
+10	8	15·2	8	13·1	8	29·3	8	22
+11	6	15	6	13·5	6	30·6	6	22·4

Differences noted in Treated Cases.—Included in the cases studied were 6 orthodontically treated cases, 4 males and 2 females. The same measurements were made on these that had been made on the untreated sample. Without exception all values were slightly higher than the means of the untreated cases, but the smallness of the sample made any conclusions dangerous (*Table III*).

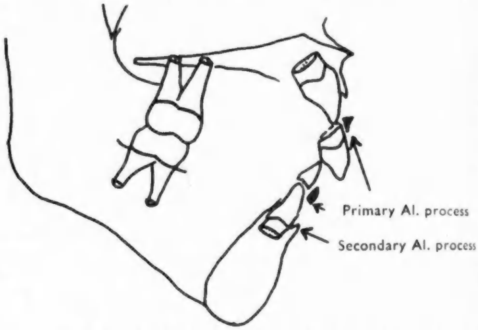

Fig. 15.—Male. Aged 6 years. Tracing of lateral X ray illustrating separation of primary alveolar process incident to eruption of permanent incisors.

Comparison of Treated and Untreated Cases.—In *Table IV* is shown a comparison of the mean increase in height of the alveolar process, with and without orthodontic treatment. The mean increase in the alveolar process during treatment was always slightly higher than in a normal case in all areas of the alveolar process.

The total dental height in the treated cases was greater than in the untreated cases, posteriorly and anteriorly. The total facial height in the male non-treated cases was always greater than in the treated cases. The reverse was true in the females (*Table V*).

Is this the influence of orthodontic treatment?

This is possible, but the small number of cases do not allow an affirmative conclusion to be expressed.

It is to this assembly of facts that I have given my name:—

1. Variations of growth in height;
2. Alveolar resorption;
3. Appearance of sequestra;
4. Rebuilding of alveolar process.

DISCUSSION

Although the phenomenon of tooth eruption has been studied by a variety of methods, it has been impossible to follow it quantitatively in the living individual until the advent of roentgenographic cephalometry. Even with this tool available it has been necessary to await the gathering of serial records over a period of years, the task undertaken by Broadbent under the auspices of the Bolton Foundation.

Table III.—Increase in Height of the Alveolar Process (Treated Cases)

Years of Eruption	Upper				Lower			
	Anterior		Posterior		Anterior		Posterior	
	No.	mm.	No.	mm.	No.	mm.	No.	mm.
−1	5	−4·6			2	−5		
+1	6	10	6	5·4	6	26·1	6	19·3
+2	5	12·6	5	7·9	4	27	5	22
+3	5	14·3	5	8·8	5	27·7	5	23·2
+4	4	13·7	4	9·7	4	26·1	4	20·5
+5	5	13·7	5	10·2	5	27·1	5	20·6
+6	5	14·4	5	10·9	5	27·6	5	20·8
+7	6	15·5	6	13	6	29·5	6	22·5
+8	5	16·8	5	13·1	5	30·8	5	24·1
+9	5	16·3	5	14·6	5	31·8	5	24·6
+10	3	15·6	3	14·3	3	30	3	23·3
+11	2	20	2	16·5	2	37	2	29

Table IV.—Comparison of Mean Increase in Height of the Alveolar Process with and without Orthodontic Treatment (Average at 17 Years)

	Treated Cases	Male (non-treated)	Female (non-treated)
	mm.	mm.	mm.
Posterior lower	23·00	27·54	22·41
Anterior lower	37·00	34·81	30·83
Posterior upper	16·50	15·50	13·58
Anterior upper	20·00	18·34	15·00

It has been taught that the deciduous teeth, even after they were completely erupted, continued to be carried upward by the growth of the alveolar processes. This growth was thought to be interrupted for a short period by the loss of a small portion of their crests which took place coincidentally with the shedding of the deciduous teeth. Following the eruption of the permanent teeth the crest continued to grow.

The present research would seem to indicate that the process is not quite as it has been described. The alveolar process seems to begin to lose height well before the deciduous teeth are lost. Also, it loses more than has been generally supposed and although it grows at its highest rate during the period of active eruption of the permanent successors it does not regain former height for several years.

Table V.—Comparison of Total Dental Height and Total Facial Height (After Puberty)

	Treated Cases	Male (non-treated)	Female (non-treated)
	mm.	mm.	mm.
Posterior total dental height	60·50	58·26	50·60
Anterior total dental height	74·66	71·27	63·66
Anterior total facial height	125·00	128·07	117·40
Posterior total facial height	86·00	87·85	78·40

If these conclusions are correct, it would mean that after the initial stage of eruption of the deciduous teeth there was a relatively long period during which there was little addition in height of the alveolar processes. During this time, however, the steady growth of the face continues with its accompanying descent of the mandible away from the maxilla. This would tend to increase the distance between upper and lower teeth when the mandible was at its position of rest. Unfortunately this could not be checked in the present study owing to the fact that all of the head X rays were taken with the teeth in occlusion.

Thought on continuous growth of the alveolar process has been unduly influenced by the investigations conducted with vital dyes on lower animals. These have invariably revealed heavy staining of the free margins of the alveolar processes which has been taken to indicate prolific growth. Instead of this, it probably denoted merely a rapid reconstruction process in response to the varied stresses that fall upon this area. The superposing of

successive tracings of the same mandible reveals clearly that the increase in height that takes place between the primary and secondary teeth is little greater than the height of the crowns of the permanent teeth in most cases (Brodie, 1948 a, b).

The differences noted in the present study of the variation in the amount of alveolar growth in different areas and particularly the greater increase of the upper over the lower posterior area, coincide with all of the recent findings on the growth behaviour of the facial skeleton. It has been found by several investigators that the posterior ends of the lower border of the mandible and of the occlusal plane tend to drop in the later stages of growth. Most of that work has been done on male samples and the increase shown by the female in the upper anterior region has not previously been pointed out. It would be interesting to determine whether this was correlated with a difference in behaviour of the mandibular lower border and the occlusal plane in the female.

The fact that the treated cases, as a general rule, yielded higher values, has implications for the orthodontist. The question naturally arises as to whether malocclusion acts as an inhibiting force which treatment eliminates, or whether the mere stimulation of treatment acts as an accelerator. It has been shown that the wearing of intermaxillary elastics tends to reverse the characteristic behaviour of the occlusal plane. A much larger sample would need to be studied before safe conclusions on these matters could be arrived at.

The lack of correlation found between the increase in height of the alveolar process and that of the total face, casts further doubt on the premise that the alveolar process is responsible for a significant amount of such growth.

SUMMARY

A study of the growth in height of the alveolar process in 30 individuals has been reported. The investigations covered the age range of 4–20 years by means of cephalometric X rays. Measurements were taken from the crest of the alveolar process in the maxilla at the incisor and first molar area, to a plane connecting the anterior and posterior nasal spines; and in the mandible, from the crest of the process at the incisor and molar area to a line representing the lower border of that bone.

The measurements revealed sex differences as well as differences in location. The amount of increase in height and of time between treated and non-treated cases revealed some variations also.

Of great interest was the loss in height of the alveolar process during the shedding of the teeth.

The assembly of facts is the O'Meyer's sign.

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Reparative Giant-cell Granuloma of the Jaw

Attention is drawn to a peculiar lesion of the jaw called reparative giant-cell granuloma. Establishing the correct diagnosis is difficult, as the differential diagnosis lies between this lesion and bona fide giant-cell tumour. Surgery seems to be the most satisfactory form of treatment. Two cases are reported and differential diagnosis is fully discussed including eosinophilic granuloma and fibrous dysplasia.—Radcliffe, A., and Friedmann, I. (1957), *Brit. J. Surg.*, **45**, 50.

CURRENT TRENDS IN PERIODONTAL RESEARCH*

By **JAMES A. ENGLISH,** Capt. D.C., U.S.N., Ph.D., D.D.S.
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THE subject I have chosen deals with research aspects of periodontology. Upon being invited to address a periodontal society, I felt that some aspect of periodontology would be most desirable as a subject, and since I have never been a specialist in this field, nor am I now engaged in clinical dentistry, research aspects seemed the only escape. Although my earlier years in the Navy were devoted to clinical dentistry it is quite a challenge for one not actively engaged in periodontal practice to speak before a group such as this. The best I can hope is that the naïve approach of an outsider may be fresh, unbiased, and able to see a general picture of periodontal disease without being influenced by special interests of his own.

In order that you may know the area I have selected to review in developing my theme of recent trends in periodontal research, I should mention the sources to which I referred. In all cases but the last reference given, I covered journals for the last three years.†

I have made a few general observations about periodontal research that I would like to get off my chest before proceeding with specific research papers.

My first observation is that there is not enough research being done in areas related to periodontal disease. In the American sessions of I.A.D.R. during the past three years there has been a total of 809 papers read and only 62 (or 7½ per cent) of these could be related to periodontal disease, even when a generous relationship was allowed. In the British Division of I.A.D.R. there were 88 papers read during the past three years, of which 7 (or 8 per cent) were related to periodontal disease. In the Scandinavian journal mentioned there have been 2 papers on periodontal disease out of 63 papers read in the last three and a half years; in the German journals there has been 1 paper out of 47 in two and a half years; and journals of the English and American national dental associations are little better. The reasons for the scarcity of periodontal research as compared with the landslide of work on dental caries in the last few years are fairly obvious. Methods for accurately registering the degree of periodontal disease are virtually non-existent, the causes of the disease are complex, evaluations of methods of treatment have been largely clinical opinions, and the interest of investigators from the basic sciences has rarely been obtained, etc. Other reasons could be listed, but they can all be lumped into one basic reason: We do not know enough about periodontal disease from a clinical point of view that it may readily be crystallized into specific problems that can be handled in the laboratory. Standardization of methods of evaluation must be made in the clinic. Until satisfactory laboratory animals for periodontal study are available, research must be closely related to the clinic.

My second observation pertains to the calibre of the research that is being reported. I will take the American work as a point for discussion, since I am more acquainted with that, but I think the criticism may apply generally. As I read the abstracts of the I.A.D.R. work reported, 1955–7, I put asterisks on items that I felt should be followed into the primary literature. When I was finished I had a dozen or so asterisks in 62 papers. Papers other than these 12 were worth while, but the findings reported were

* Read at the meeting of the British Society of Periodontology at the Eastman Dental Hospital on Nov. 11, 1957.

† In the British literature I used the British Division of I.A.D.R. *Abstracts*, the *Journal of the British Dental Association*, and the *Dental Practitioner*; in America I used the I.A.D.R. *Abstracts*, the *Journal of Periodontology*, the *Journal of Dental Research*, the *Dental Abstracts*, *Oral Surgery, Oral Medicine and Oral Pathology*, and the *Journal of the American Dental Association*; in Scandinavia I have used the Nordic Odontologic Association Abstracts and the *Acta odontologica Scandinavica*; in the German literature I referred to *Stoma*, *Zeitschrift für die wissenschaftliche Zahn-, Mund- und Kieferheilkunde*, and the *Deutsche Zahnärztliche Zeitschrift* (1957 only).

negative ones. Of course negative facts are worth reporting. However, more often the work was of a vague, descriptive, unimaginative nature. The experimental design of some of the papers I have read in most of the sources mentioned could be improved considerably. A substantial proportion of the papers deals with various surgical techniques which I am sure are interesting to the periodontist dealing with similar problems, but for the life of me I cannot tell how the writers of these papers establish a reliable evaluation of the techniques they describe. I do not wish to imply that I think these reports are worthless, but rather that when more definitive ways of evaluating periodontal disease are worked out the results of such work can become more significant.

I made a reference a moment ago to the fact that laboratory research in periodontology is hampered by the lack of satisfactory laboratory animals to use in controlled experimentation. The realization of the need for such animals has been broadly recognized, and several people are doing something about it. Perhaps some of you remember that at your British I.A.D.R. meeting in 1956 Professor Hitchin (1956) told of observations on sheep dentitions which indicated that certain strains were susceptible to periodontal disease. Some years ago, the late J. D. King (1954) observed a susceptibility in ferrets but I have found no current work on these animals. Ockerse (1956) of South Africa, has found that the white-tailed rat develops periodontal lesions when it is raised on a high-sugar diet. There seems to be no relationship between food impactions resulting from carious lesions in these rats, since no caries was present in the region where periodontal disease developed (between the first and second molars). Lack of masticatory stimulation may have been a factor, since these animals did not have to chew corn meal to get calories. Only a dozen animals having 26 lesions have been reported, so more investigation is required.

In the recent I.A.D.R. meeting in Atlantic City it was mentioned that the rice rat is susceptible to periodontitis (Gupta and Shaw, 1957 a). This animal was one of several small rodent species that Shaw, of Harvard, and his collaborators observed over a period of time for the declared purpose of trying to find a periodontitis-susceptible animal. These rats are more susceptible to the lesion on high-sucrose diets, although on laboratory chow and mixed grain diets they also get periodontal disease. The nutritional relationships will have to be studied further before the significance is certain and the mechanism clear, but the availability of a new periodontitis-susceptible animal is quite important.

Other rodents have been used for periodontal studies. I noted that white mice, white rats, and hamsters were all used several times in I.A.D.R. reports in 1955–7. Zander (1957), Linghorne (1957 a), and Waerhaug (1957) have all used dogs in periodontal studies, and a recent article by Collings (1957), of Texas, describes a surgical procedure for producing horizontal periodontitis in dogs. He removes 2–3 mm. of crestal bone buccally and lingually on both sides of the mandible, and removes some interproximal bone with a bone bur. Soft tissues are reflected prior to this, of course, and sutured back afterwards. A soft diet is fed for a fortnight. His radiographs at 2, 5, 7, and 12 weeks show a progressive deterioration of bone, but it is not clear to me *why* there is this extension of bone loss. He has done this to one bitch and several of her offspring, a total of 6 dogs.

The other animal used for periodontal studies, and perhaps the best one if there were unlimited resources, is the monkey. We all know that laboratory experimentation using animals has to be interpreted with care when the results are considered in relation to the human disease. In the case of monkeys the characteristics of the dentition are remarkably like the human, the diet can be the same as the human diet, and the problem of size of the teeth (as compared to rodents) is not so severe. There have been several studies using monkeys, but only two or three animals were involved, and this gives no advantage over using human clinical material. Perhaps some time hence the dental research of countries where monkeys are normally found will be at such a level that they can be used more economically. The original cost of monkeys is substantial, but it is the

maintenance cost and handling problems which almost prohibit their use.

Before I pass on to a systematic discussion of periodontal research, I would like to refer to a few efforts to remove the other stumbling block I mentioned—that is, the need for a good yardstick in evaluating periodontal disease. Of course you are all familar with the method proposed by Massler, Schour, and Chopra in 1950 for evaluating gingivitis (generally called the P.M.A. Index), and the objections (Sandler, 1952) to this method. The objections have arisen primarily because variable clinical opinion cannot be eliminated. I have not found a good substitute method for evaluating gingivitis, but of course this index is not useful for periodontitis. Two years ago Crowley (1955) showed that a group of dentists could not grade 40 coloured translucencies of gingiva the same in successive weeks (three tests) without a system of classification, whereas, when a system was agreed upon, reasonable consistency was obtained. In the *Acta odontologica Scandinavica*, Berhagen and Hjelmström try to apply a method of stereoscopic radiography to the periodontal problem, but I feel that it is too complicated, and that it also requires several radiographs to be taken at each location. Let us not get into the habit of taking X-ray pictures every 20 minutes, or we will next be having a new aetiology for periodontitis. Belting (1957), a public-health-oriented dentist from New York, believes that the radiograph provides the most objective means available for assessing periodontitis, and that in addition this provides a permanent record. His investigations indicate that the radiographic observations will indicate alveolar bone changes in 12 per cent of patients in whom periodontal pocket formation does not exist clinically. Russell (1956), who is the head of the statistical section of the N.I.D.R. in Bethesda, has devised a system for classification and scoring of periodontal disease which uses only positive signs as an indication of disease: The supporting tissues of each tooth of the patient are scored individually according to a progressive scale which puts a heavier evaluation on bone involvement than it does on soft-tissue involvement. The score of each patient is obtained by arithmetically averaging the scores of all individual teeth. This permits a quantitative comparison within the human population. This method, or some modification of it, may prove to be what is needed for evaluating periodontitis, if we can only get all periodontists to agree to use it.

Now I should like to refer to studies that are more directly related to periodontal disease. A convenient way of organizing this work will be to divide periodontology into aetiology, prevention, treatment, and epidemiology. As one reviews the literature it becomes apparent that more is written about aetiological factors than about all other aspects combined. This may point to the fact that a complete understanding of the causes of periodontal disease has not yet been obtained. In general, it is believed that periodontal disease is the end-result of a complex interplay of multiple aetiological factors (Glickman, 1955). In the normal person these factors are in equilibrium; however, if one or more of these factors falls out of balance, periodontal disease begins. Perhaps the foremost of these factors is *gingival inflammation*, which in itself has a variety of causes, such as poor oral hygiene, nutritional lack, hormonal imbalance, systemic disease, or a massive local infection, as occurs in acute necrotizing gingivitis (Vincent's infection). Studies have been done to relate gingival capillary changes with the degree of gingival inflammation and learn something of its mechanism by making microscopical examinations of the human gingiva *in vivo* under a variety of clinical conditions. In England Staples (1957 a) and in Germany Spreter von Kreudenstein (1957), have adapted high-power surgical microscopes to this use. Von Kreudenstein has found that dilute solutions of phenol are effective in reducing slight swelling and moderate reddening of gingiva if there is no calculus present. Studies relating oral hygiene to inflammation will be considered under prevention.

The second most prominent aetiological factor in periodontal disease is *calculus*, but differences of opinion exist as to the degree of importance of this factor. Clinical reports

frequently point out the lack of correlation between the amount of calculus present and the amount of periodontal destruction, and one must conclude that both calculus and gingivitis are contributing factors rather than initiating ones. The nature of the actual calcified deposit has been studied histologically, chemically, histochemically, and by physico-chemical means. A good example of the last type of investigation is that of Jensen and Rowles (1957) in *Acta odontologica Scandinavica* this year. Their studies reveal, by means of X-ray diffractograms, that oral calculus is different from the tricalcium phosphate of teeth and bones, but that it is rich in the mineral whitlockite. The importance of careful scientific studies of this kind cannot be over-emphasized. If substantial differences between the structural units of calculus and teeth are found, then it may be possible to find chemical or physico-chemical ways of attacking the former without damaging the latter. In America, Wah Leung has been studying synthetic calculus formation from electrodialyzed saliva (1956) and methods for producing artificial calculus *in vitro* (1957). By these studies he hopes to learn something of the mechanism of calculus formation, as well as to provide a means for testing, under controlled conditions, agents that inhibit calculus formation. From an investigational point of view, testing such agents in human populations meets with almost insurmountable difficulties due to the variability of people and the way they live.

It is generally agreed (Kreshover, 1956) that various micro-organisms, particularly the *Actinomyces* and *Leptothrix*, are responsible for the formation of the organic matrix of calculus. However, there is varied opinion as to the source of mineral salts in subgingival calculus. Waerhaug (1955), of Norway, carried out a novel clinical study in which he exposed the gingival margins of periodontal pockets in patients with extensive subgingival calculus, to dyes such as methylene blue and alizarin red. Inasmuch as no dye penetrated below the gingival margin after a lapse of 6–10 hours, it was concluded that saliva might have the same difficulty in penetrating into the pocket. Waerhaug interprets this as partial evidence that the blood provides the source of mineral salts in subgingival calculus. Of course, we know that calcified material can appear in the walls of arteries in arteriosclerosis, and the source of salts is probably the blood in this case. Permeability of the gingival tissues to salts can be altered in subacute inflammatory conditions. Of course, this tentative theory of the mechanism of subgingival calculus formation needs to be studied much more.

Another frequently stressed factor in periodontal disease is the condition called *occlusal trauma*. Again we find clinical inconsistencies, for in some persons a severely traumatic dental relationship is tolerated by the periodontium, whereas in another case a mild prominence of cusps appears to be a factor in the loosening of teeth. Some experimental work has been done on animals to try to establish the importance of occlusal trauma. Orban and Bhaskar (1955) used monkeys, and by raising the bite in selected teeth they observed thrombosis and crushing of connective-tissue fibres within three days, root resorption in three weeks, and eventual repair of the root surface and alveolar bone after three to six months. No periodontal pockets were formed at any time. Glickman and Weiss (1955) subjected dogs to experimentally induced occlusal trauma and found lesions of a periodontal nature only when other factors, such as local inflammation or calculus, existed simultaneously. They believe trauma is a complicating or predisposing condition rather than an initiating factor in chronic periodontal disease. Stahl, Miller, and Goldsmith (1957) have used rats, combining vertical occlusal trauma with protein deprivation. They find that when trauma alone is present, little change occurs, but, in conjunction with protein deprivation, trauma causes degeneration of the periodontium. There have been many clinical studies reported in which the removal of occlusal stresses has been found to be beneficial. I regret to say that many of these studies are in the nature of case reports, and one never knows whether the unsuccessful cases are forgotten, and in other more extensive clinical investigations the parameters of reference are not clearly defined.

Mühlemann (1957), of Switzerland, offers the most convincing evidence, in that his selective grinding procedures are tested by tooth mobility measurements. He has an internally applied mechanical device that measures the amount of movement to which each tooth is subjected upon application of a standard pressure. His data indicate that selective grinding procedures can reduce mobility in a hypofunctioning quadrant of the mouth by 18 per cent and in a hyperfunctioning quadrant by about 9 per cent.

Numerous studies have been done to relate various *micro-organisms* to periodontitis. Lisanti and Chauncy (1956, 1957), at Tufts College, and Reynolds (1957) in Toronto, find hyaluronidase activity in the saliva in periodontitis and relate this to the type of bacteria which may be present. However, many different organisms are found in periodontal disease, and none has been isolated as a specific cause. Thonard and Scherp (1956) cultivated gingival bacteria and then studied the activity of these organisms *in vitro* on the collagen of human periodontal tissue. They observed that only collagen which had been altered in some way was susceptible to attack.

Time does not permit me to describe the studies which investigate the relationship of loss of teeth to periodontitis (Stanmeyer, 1956), or the effects of dietary thyroid (Bavetta, Bernick, and Ershoff, 1957), or the effects of testosterone (Shklar and Glickman, 1956), or the effects of stress (Krikos, 1957), or nervous factors (A. Tobin White, 1954) on periodontitis. However, before I leave the subject of aetiology I must discuss *systemic susceptibility* to periodontitis, since this may be the single most important aetiological factor. Each of the preceding possible causes of periodontal disease I have mentioned may be resisted, when occurring alone, if one's constitutional resistance is high. Therefore, we need to have a better understanding of this resistance, or conversely, of what happens when the resistance is lowered. I will refer to only two papers on this subject.

Gans, Engle, Laskin, and Joseph (1956) have done electrometric studies of human alveolar bone and gingival tissues in periodontitis. Liquid junction potentials were determined between sodium chloride solutions and alveolar bone and the gingiva, for both normal and periodontitis cases. There are well-established physicochemical relationships by means of which one can estimate the relative concentration of immobile, negatively charged colloid in connective tissue, by determining a set of dilution potentials. In this study the investigators found significantly different dilution potential values for diseased and normal tissues, which indicated that in periodontitis there is a disaggregation of the connective-tissue colloids. Such changes would necessarily be accompanied by shifts in tissue water and electrolytes.

Another study by Engle, Laskin, and Gans (1957) undertakes the measurement of serum mucoproteins in periodontitis and healthy individuals. A significant elevation of about 3 mg. per cent of serum mucoproteins is observed in periodontitis. This suggests that periodontitis may be a local manifestation of a more general connective-tissue disturbance. In my opinion information of the kind obtained by this paper, and the preceding one, deserves our careful consideration. Since actual physical measurements are made, the results are amenable to statistical evaluation. I believe papers of this kind are most likely to provide a break-through to an understanding of the mechanism of periodontitis.

The next category I wish to discuss is *prevention* of periodontal disease. Practically no research has been done on prevention. I found three or four studies that were designed to evaluate the effectiveness of tooth-brushing. Stanmeyer (1957) studied some 3000 U.S. Navy personnel, using quite careful controls, and found that one tooth-brushing per day caused a significant decrease in gingivitis, two brushings a day caused some improvement over one, but that three brushings a day were little better than two. In another study, Goldman's (1956) findings were not much different except that he observed that when people already have periodontal disease a single brushing is not as efficient, probably because there are more places for food to collect in and because there is more need for

massage. The other studies I have seen on prevention were inconclusive. I do not mean to imply that there are not other good papers —for example Trott and Wade (1955) have a fine technical paper on "Bite Analysis and Selective Grinding in Dental Practice", but it is not a research oriented paper.

The third division of our subject deals with *treatment*. I found two amusing poems about treatment in the *Journal of Periodontology*. I will not repeat them completely, but since many of you may not read that journal, I will give a few lines. The first one is a parody on Shakespeare (M. K. H., 1956), and goes like this:

> To treat or not to treat: that is the question:
> Whether 'tis nobler for the patient to suffer
> the pain and anguish of lengthy treatment
> or to accept the forceps on some weakened teeth
> and by extracting end the problem. . . .

and so it goes on for twenty-two more lines. It is by M. K. H. (who I suspect is Maynard Hine).

The second poem is by a patient at the University of California Dental School (1957). It has the title "In Periodontia, In Extremis".

> Perio, Oh Perio
> The teeth are good, but the gums must go
> The doctor says, and he should know
> That's why I sing of Perio.

There are six other verses.

These two poems provide a good setting for the studies I have read on the treatment aspects of periodontal disease. The problem of determining just which patients are reasonable treatment-risks is not resolved easily. Of course, when the periodontist is fortunate enough to get a patient with incipient signs of periodontal disease, it is an easy decision for him to recommend that calculus be removed, oral hygiene improved, traumatic stresses relieved, and nutritional factors checked. But when a case of true chronic degenerative periodontosis in a young adult is presented, particularly if there seems to be reasonable oral hygiene, good occlusion, and no apparent systemic disease, the periodontist is in a quandary. I found no investigations designed to answer this problem other than those related to systemic causes for periodontosis, which I have previously illustrated. In those instances where patients have vertical bone loss in one or two areas, rather than a general or horizontal loss of alveolar bone, the prognosis appears more hopeful. I will not try to classify the types of surgical procedures that have been described for treating such lesions, but I will mention several isolated innovations that may be worth watching. Frumker (1956), in America, has used the enzyme trypsin to assist in the débridement of severe gingivitis, and Sosted (1957) of Denmark has also shown some clinical pictures in the Helsinki meeting this year of similar techniques for removing necrotic tissues in dry sockets. The local use of proteolytic enzymes by these investigators was favourably reported, and further work seems to be worth while. Gupta and Shaw (1957 b) reported that when 0·05 per cent additions of penicillin or streptomycin were made to the diet of rice rats suffering from periodontosis, there was a marked improvement. I do not know what the mechanism may have been—actually, it could be nutritional as well as antibiotic—but such findings are worth following. Lucas (1955), of London, reported in 1955 that 30 p.p.m. of aureomycin added to the diet of mice does not prevent superficial gingival damage in animals receiving pyridoxine-free diets. A more direct method is being applied by Cross (1957), who is investigating the practicability of replacing lost alveolar bone (in selected cases) with specially prepared bovine bone. This bovine bone has been treated with a deproteinizing agent, and it has been observed to be revitalized more rapidly than autogenous bone when used as an implant medium. Cross's early findings indicate that this technique may be of considerable value.

The problem of eliminating periodontal pockets has been the subject of clinical reports for many years. The usual sequence of claims and counterclaims, and choosing sides, often becomes more emotional than scientific. One group maintains that all of the epithelium lining a pocket must be removed for reattachment to occur. Linghorne (1957 b), of Toronto, experimenting with dogs, showed that following the removal of debris and tartar and the formation of a blood-clot, the

blood-clot can be re-organized and supporting structures can regenerate even though the epithelium is not removed. Rather opposite results were observed by Morris (1955), who performed careful treatment of 15 periodontal pockets in clinical cases. He cleaned outer cemental layers and removed debris from the pockets as well as the epithelium of the soft wall. He hoped a clot would form in the pocket, granulate, and new connective tissue would form a union with the root. Subsequent histological sections of these 15 cases showed that no actual change in the depth of the pockets had resulted from this treatment.

The final subject I would like to discuss is the *epidemiologic* investigation of periodontal disease. This is a subject that could in itself be a topic for one of your meetings, and in fact I recommend it. I can only express one or two observations: We are again faced with the fact that this important subject has been very neglected. Probably our poor methods of recording periodontal disease is one reason for this. Important clues on aetiology and treatment could be learned from accurate population studies. It is clear from studies that have been done that periodontal disease is even more widespread than dental caries, for whether we study primitive types in Egypt, as Wheatcroft (1957) did; the peasants of India, as Marshall-Day (1955) did, or the business man of Canada, as Mehta, Granger, and Williams (1956) did, we see that periodontal disease begins at puberty and progresses exponentially with age until at retirement age less than 10 per cent of the population have escaped.

I will summarize my paper very concisely: The periodontal research of a few Western European and North American countries has been analyzed on the basis of reports appearing in their leading research and clinical journals. It is apparent that important research areas have been overlooked in current investigations, notably research in prevention and well-conceived epidemiologic studies. The single most urgent problem is to devise sound criteria for evaluating periodontal disease. The most hopeful trend in periodontal research is the increase in the number of studies which use the techniques and principles of the basic sciences in attacking the problems. There are many valuable investigations of non-dental degenerative diseases in the literature, and a few dental investigators are applying these to dentistry. Some good clinicians are becoming good scientists, some scientists are becoming clinicians, and in rare instances fruitful teamwork between clinicians and basic scientists may be seen.

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BOOK REVIEWS

ORAL HYGIENE. By RUSSELL W. BUNTING, D.D.S., D.D.Sc., D.Sc., and collaborators. Third edition. $9\frac{1}{2} \times 6\frac{1}{4}$ in. Pp. 334, with 233 illustrations. 1957. London: Henry Kimpton. 52s. 6d.

THE title "Oral Hygiene" is considered misleading, for the preface states that "this text is directed specifically to the needs of dental hygienist education". The subject matter is extensive and embraces not only all aspects of oral hygiene, but includes chapters on development of face and jaw, and anatomy and physiology of the mouth. These chapters together with that on histology and embryology of face and oral structures are very lucid, and although brief, provide sufficient coverage.

The chapter on accretions on the teeth is most exhaustive, with more detail than many standard texts used by dental students. Caries is given extensive coverage—particularly the preventive and immunological aspects—which prompts the suggestion that too much detail has been included in a book of this type.

Periodontal disease is well explained and is one of the few sections in which an attempt has been made to define some of the terms used. The importance of the "local factor" in periodontal disease is stressed convincingly. Oral prophylaxis is well presented.

The chapters on Public Health, Dental Health Education, and the History and Organization of Dental Hygiene are included primarily for the benefit of dental hygienists in the United States.

There is some repetition and lack of continuity which may be attributed to the method of each collaborator contributing a single chapter, but nevertheless, R. W. Bunting and his eleven co-authors have achieved a commendable object. The text is well illustrated and there is much of value to the dental hygienist—in fact, dental students about to enter their clinical training could well benefit from this book.

B. G. R.

REGULATION OF DENTAL PRACTICE. A Survey of the Legal and Educational Requirements for the Practice of Dentistry and Dental Surgery in Different Parts of the World. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 144. 1957. London: General Dental Council. 10s.

THIS book, produced by the General Dental Council with the co-operation of the Fédération Dentaire Internationale, is a survey of the legal and educational requirements for the practice of dentistry and dental surgery in different parts of the world. There is little doubt that a tremendous amount of work has gone into the compilation of material from so many different countries. It is an account that has long been wanted and will undoubtedly prove exceptionally useful to everyone interested in dental education and dental politics.

The book is arranged in three parts, giving the legal and ethical conditions of practice, the degrees and diplomas in dental surgery, and the special particulars under which dentistry is practised, listed under the name of each country. When it is realized that particulars are given of 132 separate countries, the 48 states of the United States of America, and the 12 provinces of Canada, it is easily understood that this book is a mine of information and the many people responsible for its production are to be congratulated on this worth-while effort.

N. L. W.

NEW MATERIALS AND APPLIANCES

COMPRESSED-AIR HANDPIECE

The Atlas Copco air-turbine shown in prototype form at the exhibition in Paris last December was recently demonstrated at the Rome Congress by its inventor, Dr. Norlen.

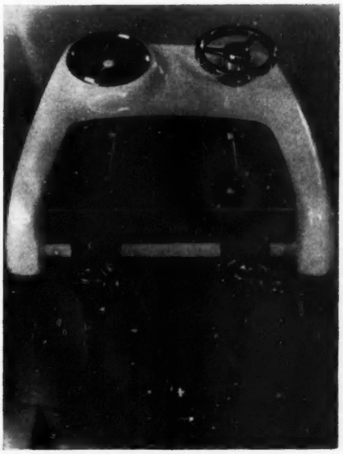

Fig. 1.—Dentalair stand.

Capable of 50,000 r.p.m., the apparatus now comprises three main components: the Dentalair stand, the instrument head, and the compressor. A synchronized spray has been added consisting of a spray bottle and heater, a solenoid valve, a micro-switch, and a three-way valve.

The turbine motors and attached handpieces, when not in use, are kept in two spring-activated hangers on the front of the stand. The hangers also act as automatic cut-off valves. The reducing valve control wheel and air-pressure gauge are located on the head of the stand. The speed of the bur is controlled by a spring on the outer casing of the handpiece, as can be seen in the illustrations. At the high speeds at which these handpieces operate, it is only necessary to exert about one-thirtieth of the pressure required with orthodox

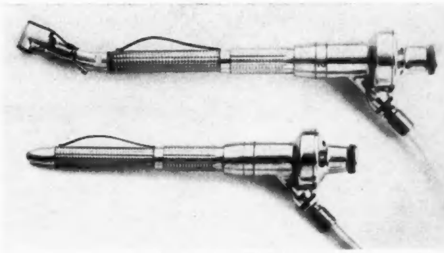

Fig. 2.—Handpieces.

Fig. 3.—Handpieces in operation

equipment, thus considerably reducing patient discomfort.

The Atlas Copco Company of Sweden, manufacturers of the equipment, have developed it from the original invention of Dr. Ivar Norlen. No information is at present available concerning price, the equipment being at present restricted to the Swedish market.

COPPER-FORMING DENTAL UNIT

A compact unit for electro-forming impressions has recently been put on the market. It is in grey hammer-finish sheet steel. A variable resistance and a three-position switch providing graduated readings in ma. up to 1 amp. give it a very adequate range. The anode and cathode bars are on long leads, allowing the unit to be mounted on a wall bracket. (Made by the Transformer and Electrical Co., Ltd., Basildon, Essex. Price 17 gns.)

LETTERS TO THE EDITOR

January 3, 1958

Dear Sir,

I realized that my Presidential Address would produce comment from the anatomist Dr. J. Scott. I carefully considered the manner in which I should express my opinions and decided that in such an assessment I was entitled to make dogmatic statements—very briefly for the following reasons:—(1) As the result of over twenty years of clinical observation by inductive reasoning certain conclusions have been reached. (2) These conclusions are entirely in accord with those that Brash had expressed in his Dental Board Lectures. (3) The conclusions I have come to are in accord with the present-day view on the inter-relationship through evolution of form and behaviour.

There is a fundamental difference of opinion between myself and Dr. Scott which cannot be resolved in the correspondence columns of this JOURNAL. In my opinion he lays far too much stress on environment. This is not in accord with clinical experience or with the present-day views of the inheritance of variations. There is no space to quote the extensive literature on which I base this statement. Some I have referred to elsewhere.

Dr. Scott talks about the "complex processes involved in the aetiology of malocclusion". From the anatomist's point of view there may be complex processes involved in the development of a malocclusion, but as I have previously said by inductive reasoning we now no longer regard the aetiology of malocclusion as being a complex problem. Dr. Scott queries to whom our reasoning is evident. I would state quite clearly that it is evident to myself as a clinician, and I believe there are now a fair number of my colleagues who, having the same evidence as myself, agree with me.

Yours faithfully,

C. F. BALLARD.

Eastman Dental Clinic,
Gray's Inn Road,
*London, W.C.*1.

January 14, 1958

Dear Sir,

Owing to an unfortunate combination of circumstances, the article on the Principles of Ultrasonic Cavity Preparation in the December issue of the DENTAL PRACTITIONER appeared entirely without my knowledge.

As mentioned in the footnote, this brief and somewhat informal communication was delivered to the American Dental Society of Europe in July, 1956, and was subsequently printed, with only minor corrections, in the Society's Transactions. These, it might be mentioned, are printed for limited circulation to the Society's members by the publishers of the DENTAL PRACTITIONER. I see that my article has now been transposed into your Journal without alteration.

I would suggest that a distinction should be made between what is very nearly a verbatim report of an informal presentation, circulated privately, and an original article in a scientific journal. I feel that the communication under my name does not measure up to the latter standard since, apart from the material now being to some extent out of date, it lacks proper illustration and an adequate number of references, and in addition contains some over-simplifications which are out of place in a published scientific paper.

I therefore cannot help having some feelings of regret that this article, as far as I am concerned, has been accidentally published.

Yours faithfully,

G. A. MORRANT, B.D.S., D.D.S.

Eastman Dental Hospital,
Gray's Inn Road,
*London, W.C.*1.

A Study of the Distribution of Nerves in Human Teeth

Research has yet to demonstrate the basis of the extreme sensitivity of the dental structures. Permanent, non-carious teeth were used and decalcified sections impregnated by silver; the Powers' modification of the Romane stain being selected as the most suitable technique. The identification of neural tissue is complicated by the argyrophilic property of the precollagenous fibres of connective tissue.

The findings from the sections were that large neural trunks run from the apical foramina to the pulp chamber where they branch to form a subodontoblastic network of fibres. Most neurofibrils pass from this network through the cell-free zone of Weil where they lose their myelin sheath and terminate among the odontoblasts. No neural endings were noted on the odontoblasts or on their protoplasmic processes. A few fibres were seen to arise from the subodontoblastic network and enter the predentine for a short distance. Some of the fibres follow an intratubular course while others appear to be in the matrix of the predentine between the tubules. The ends of the neurofibrils loop back towards the pulp. Some fibres terminate in bulb-like endings, others in free endings.

As side issues it was considered that a plexus of nerve-fibres, the plexus of Raschkow, does in fact exist, and that the layer of Weil is a narrow zone, free of cells, containing a network of fine fibres situated subjacent to the odontoblastic layer.—RAPP, R., AVERY, J. K., RECTOR, R. A. (1957), *J. Canad. Dent. Ass.*, **23**, 447.